Government of **Western Australia**
Department of **Water**

Nannup Water Reserve

Drinking water source protection plan

Providing water to the Bridgetown Regional Water Supply Scheme (Bridgetown, Boyup Brook and Hester)

Looking after all our water needs

Water resource protection series
Report WRP 131
April 2012

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Department of Water
168 St Georges Terrace
Perth Western Australia 6000
Telephone +61 8 6364 7600
Facsimile +61 8 6364 7601
National relay service 13 36 77
www.water.wa.gov.au

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For more information about this report, contact
Water source protection branch on +61 8 6364 7600 or
drinkingwater@water.wa.gov.au

Cover photograph: *Water tank within Water Corporation compound for Nannup production bore 1/07*

Disclaimer

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Contents

Summary

The town of Nannup is within the Blackwood Valley and is approximately 290 km south of Perth, 100 km south of Bunbury and 100 km east of Margaret River (see Figure A1).

The proposed Nannup Water Reserve will be a small water reserve located in the town of Nannup, within the Shire of Nannup. It will consist of one confined aquifer production bore within a fenced compound. The production bore 1/07 was commissioned in 2009 and water from this bore is pumped to Millstream Dam to supplement the surface water sources of the Bridgetown Regional Water Supply Scheme. The bore is also used as an emergency backup supply for Nannup.

The Bridgetown Regional Water Supply Scheme is operated by the Water Corporation and it supplies drinking water to approximately 2 800 people in the towns of Bridgetown, Boyup Brook and Hester (Australian Bureau of Statistics 2006). Progressive expansion of this scheme to nearby towns is planned.

Given that production bore 1/07 abstracts water from the Yarragadee aquifer, which is locally confined, there is negligible risk of it becoming contaminated by land uses occurring above it.

The key recommendations of this plan are to:

- Proclaim the proposed Nannup Water Reserve under the *Country Areas Water Supply Act 1947* (WA). This will ensure it is recognised in legislation as a public drinking water source area.
- Include the location and purpose of the proposed reserve in the Shire of Nannup local planning scheme and other applicable schemes and strategies. This will ensure land use and development planning processes consider the location and importance of this drinking water source.
- Apply best management practices to the construction and operation of existing or any future confined aquifer bores around the Nannup Water Reserve. This will ensure other bores are constructed in a manner that prevents them causing contamination of the confined aquifer.

1 The Bridgetown Regional Water Supply Scheme

1.1 The drinking water supply system

The current Bridgetown Regional Water Supply Scheme (BRWSS) supplies drinking water to Bridgetown, Boyup Brook and Hester. It is planned to progressively connect the towns of Greenbushes, Balingup, Mullyalup and Kirup to the scheme. Additionally, it is planned that Nannup, which currently has its water supplied from Tanjannerup Creek Dam, be included in the BRWSS when this source needs to be augmented (Water Corporation 2010).

The first step in protecting water quality is to manage the catchment. Filtration and disinfection are important subsequent steps. This approach is endorsed by the *Australian drinking water guidelines,* 2011 (ADWG) (NHMRC & NRMMC 2011) and reflects a risk-based, multiple-barrier approach for providing safe drinking water. This combination of catchment protection and water treatment delivers safe drinking water more reliably and at a lower cost to consumers than either approach could achieve individually.

For more information on why it is important to protect public drinking water sources such as those comprising the BRWSS, please refer to Appendix D.

Nannup production bore 1/07 has a depth of 408 m below ground level and draws groundwater from the confined Yarragadee aquifer. This groundwater is pumped to Millstream Dam to supplement the surface water sources of the Bridgetown scheme. Water is drawn from Millstream Dam at a pumping station about 15 km from Bridgetown, where it is treated by ultraviolet radiation and chlorination. Water is then pumped to a reservoir in Bridgetown, prior to reticulation to consumers (Water Corporation 2010).

Works are under way to raise the Millstream Dam wall and more than double its storage capacity, i.e. from 0.4 to 1 GL. This will allow more surface water to be captured during wet years and provide more storage in dry years (Water Corporation 2010).

Any effects of the abstraction at production bore 1/07, and the aquifer condition in general, are measured by regular assessment of water levels in several monitoring bores in the area.

1.2 Water management

1.2.1 Licence to take water

Water resource use and conservation in Western Australia (WA) is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914*. This Act regulates the right to use and control water. This means that a licence is required for drilling bores and abstracting groundwater (pumping water from a

bore, spring or soak) within proclaimed groundwater areas throughout the state. Some exemptions may apply, such as abstracting water for domestic or stock watering purposes.

The Water Corporation holds a licence to take water from Nannup production bore 1/07 for drinking water supply to the Bridgetown Regional Water Supply Scheme (BRWSS). This licence is for a nine year term. GWL163210(4) allows abstraction

of 1 090 000 kL per annum from the Perth-Yarragadee South aquifer within the Karri Groundwater Area.

1.2.2 Water planning

South West Regional Water Plan 2010–2030

The *South West Regional Water Plan 2010–2030* (DoW 2010a) outlines our strategic actions to achieve integrated sustainable water resource management in the region. The regional water plan introduces seven water resource management themes that cover all the major issues facing the region.

The regional water plan recognises the importance of protecting public drinking water source areas (PDWSA) under theme 5: *Provide integrated water services for urban communities*. The development and implementation of drinking water source protection plans are strategic actions put forward to achieve the objective: *Government and water utilities provide an integrated approach to water service management and delivery for viable and healthy communities*.

South West groundwater areas allocation plan

The South West groundwater areas allocation plan (DoW 2009) provides our direction for the allocation of groundwater in the south-west area. As such, the plan describes the water resources available and groundwater allocation within the areas – based on the department's policies and objectives for licensing and allocating water.

The Yarragadee aquifer in this area has reached its allocation limit for non-drinking water purposes. The allocation plan takes into account both the region's current drinking water use and future demand.

1.2.3 Future water needs

Nannup production bore 1/07, increased storage at Millstream Dam and planned progressive expansion of the Bridgetown Regional Water Supply Scheme will address the foreseeable water supply needs of the towns covered by the scheme into the future.

1.3 Characteristics of the catchment

1.3.1 Physical environment

The proposed water reserve area is located approximately three kilometres from the Nannup town centre. The Blackwood River is at the bottom of a moderate slope to its east.

Most of the site (which is on freehold land owned by the Water Corporation) has been cleared of vegetation during past agricultural use and is covered with pasture. However, it is mostly surrounded by native forest. Refer to Figures 2 and 3 and Appendix C – Photographs.

1.3.2 Climate

The Nannup area has a Mediterranean type climate with warm, dry summers and cool, wet winters. Average temperatures range from 13 C to 30 C in January to 4 C to 16 C in July. Average rainfall for the region is 732 mm per annum with the majority of rainfall occurring between May and September (Bureau of Meteorology 2011).

1.3.3 Hydrogeology

In the locality of Nannup production bore 1/07 the Leederville aquifer is present at the surface with the Parmelia formation underlain by the Yarragadee aquifer. The Parmelia formation provides a confining layer between the comparatively shallow Leederville aquifer and the deep confined Yarragadee aquifer.

Recharge of the Yarragadee aquifer in the area is both by downward infiltration from the Leederville aquifer and by direct infiltration where the landscape outcrops. (Water Corporation 2010)

1.4 How is the drinking water protected?

The Nannup source (production bore 1/07) is not yet proclaimed under the *Country Areas Water Supply Act 1947*.

The confining layers of clay and rock, in the Parmelia Formation above the Yarragadee aquifer, act as a natural barrier to contamination from surface land uses and activities.

Production bore 1/07 is sealed and capped to prevent the inflow of potentially contaminated surface waters to the aquifer. The Water Corporation ensures the integrity of the seals and capping of production bores by regular inspection and maintenance.

The Water Corporation employs best management practice for operating and managing production bores, water treatment plants and compounds (Water Corporation 2011).

1.5 Other useful information

1.5.1 Other groundwater bores in the area

When bores used for other purposes (e.g. irrigation) are located near a public drinking water supply bore they need to be properly constructed so they do not cause contamination. For example, a poorly constructed private bore may introduce contaminants from surface leakage down the outside of the bore casing, into an otherwise uncontaminated aquifer.

Poorly constructed bores in a confined aquifer may also create a connection across the protective confining layer. Contaminants in the superficial aquifer may then be introduced into the confined aquifer along this pathway.

It is therefore important to ensure that these bores are appropriately located and constructed to prevent contamination of the public drinking water source. All bores should therefore be constructed in accordance with *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003).

2 Common contamination risks

This information is provided to demonstrate the risks commonly associated with public drinking water sources. These risks are considered negligible for the proposed Nannup Water Reserve because of the confined nature of the aquifer, the depth of the abstraction and the construction standards of the bore used. These factors act to protect the water source from possible contamination risks at or near the surface of the proposed reserve.

A wide range of microbiological, chemical and physical contamination risks can impact on water quality and therefore affect the provision of safe, good quality drinking water to consumers.

Some contaminants in drinking water can affect human health. Other impurities can affect the water's aesthetic qualities, including its appearance, taste, smell and 'feel' but are not necessarily hazardous to human health. For example, cloudy water with a distinctive odour or strong taste may not be harmful to health, but clear, pleasant-tasting water may contain harmful, undetectable microorganisms (NHMRC & NRMMC 2004). Contaminants can also interfere with water treatment processes, and destroy water supply infrastructure (such as pipes).

2.1 Microbiological

Pathogens are types of microorganisms that are capable of causing illness, in particular bacteria, protozoa and viruses. Throughout the world a number of pathogens are commonly known to contaminate water supplies. These include: bacteria (e.g. salmonella, *Escherichia coli* and cholera), protozoa (e.g. *Cryptosporidium*, *Giardia*) and viruses. *E. coli* counts provide an indication of the level of faecal contamination.

Pathogens that may contaminate drinking water supplies are commonly found in the faeces of humans and domestic animals (such as dogs and cattle). When faecal contamination occurs at a groundwater source it is by an indirect mechanism – i.e. by faecal material infiltrating the soil and then entering the groundwater. For example, contamination may originate from septic tanks or grazing animals.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (e.g. humans and domestic animals), the transfer to and movement of the pathogen in the water source and its ability to survive in the water. The percentage of humans in the world that carry pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich 1996).

The survival and movement of pathogens in groundwater is influenced by the characteristics of the pathogen (such as its size and the length of time it normally takes to decay) and the groundwater properties (including flow rate, porosity, amount of carbon in the soil, temperature, and pH). Inactivation rate (the time it normally

takes a pathogen to decay) is one of the most important factors limiting how far pathogens can migrate. Typical half-lives of pathogens range from a few hours to a few weeks. For example, some reported migration distances of bacteria in groundwater are:

- 600 m in a sandy aquifer
- 1000 – 1600 m in channelled limestone
- 250 – 408 m in glacial silt-sand aquifers (Robertson & Edbery 1997).

Therefore it is important to understand the groundwater system to be able to protect the drinking water source from pathogens.

When people consume drinking water contaminated with pathogens the effects may vary considerably, ranging from mild illness (such as stomach upset or diarrhoea) to hospitalisation and sometimes even death. During 2000, seven people died in Walkerton, Canada, because the town's water supply was contaminated by a pathogenic strain of *E. coli* and campylobacter (NHMRC & NRMMC 2004). Where possible, avoiding the introduction of pathogens into a water source is the most effective way to protect public health.

2.2 Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water (cloudiness). Increased turbidity can result in cloudy or muddy-looking water, which is not very appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens can adsorb onto soil particles and may be shielded from the effects of disinfection. Chemicals can also attach to suspended soil particles.

Some physical properties of water such as pH (a measure of acidity or alkalinity) can contribute to the corrosion and encrustation of pipes. Other properties such as iron and dissolved organic matter can affect the colour and smell of water. Although not necessarily harmful to human health, coloured or 'hard' water will not be as appealing to consumers. Salinity can affect the taste of drinking water.

2.3 Chemical risks

Chemicals can occur in drinking water as a result of natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC 2011). A number of these chemicals (organic and inorganic) are potentially toxic to humans.

Pesticides include agricultural chemicals such as insecticides, herbicides, nematicides (used to control worms), rodenticides and miticides (used to control mites). Contamination of a drinking water source by pesticides (and other chemicals) may occur as a result of accidental spills, incorrect use or leakage from storage areas. In these cases, the relevant authorities should be notified promptly and the spill cleaned up to prevent contamination of the drinking water source.

Hydrocarbons (e.g. fuels, oils) are potentially toxic to humans, and harmful chemical by-products may be formed when they are combined with chlorine during the water-treatment process. Hydrocarbons can occur in water supplies as a result of spills and leakage from vehicles.

Drinking water sources can also be contaminated by nutrients (such as nitrogen) from fertiliser applications, faulty septic systems, leach drains and from domestic and feral animal faecal matter that washes through or over soil and into a water source. Nitrate and nitrite (forms of nitrogen) can be toxic to humans at high levels, with infants younger than three months being most susceptible (NHMRC & NRMMC 2011).

Other chemicals and heavy metals can be associated with land uses such as industry and landfill. These may enter drinking water sources and could be harmful to human health.

3 Contamination risks to Nannup bore 1/07

3.1 Water quality

The Water Corporation regularly monitors the quality of raw water from Nannup production bore 1/07 for microbiological, health-related and aesthetic (non-health-related) characteristics. After the abstracted water is treated an assessment of its quality is also made against the *Australian drinking water guidelines* (ADWG). This assessment is made by an intergovernmental committee called the Advisory Committee for the Purity of Water that is chaired by the Department of Health.

A water quality summary for Nannup production bore 1/07, between February 2010 and September 2011, is presented in Appendix B. For more information on water quality, see the Water Corporation's most recent drinking water quality annual report at <www.watercorporation.com.au> What we do > Water quality > Water quality publications > then click on the most recent *Water quality annual report*.

3.2 Land uses and activities

The proposed Nannup Water Reserve is located on freehold land owned by the Water Corporation.

Given that the drinking water from the production bore used is drawn from a deep confined aquifer and the bore is appropriately constructed and sealed, there is negligible potential for contamination from surrounding land uses. This is because confining layers of clays and rock that sit above the groundwater resource act as barriers to contamination.

4 Protecting your drinking water sources

The objective of this plan is to ensure that reliable and safe drinking water is available from the production bore in the proposed water reserve, for use in the Bridgetown Regional Water Supply Scheme.

4.1 Proclaiming the public drinking water source areas

This plan recommends proclamation of the proposed Nannup Water Reserve under *Country Areas Water Supply Act 1947* (WA) (Figure A3).

A small water reserve (approximately 20 m^2) is proposed for the fenced Water Corporation compound around Nannup production bore 1/07.

At the time of proclamation, the department will consider defining the boundary of the water reserve as the compound or as a larger area within the lot managed by the Water Corporation, depending on advice from the Water Corporation at that time.

Once the water reserve is proclaimed, the Shire of Nannup should incorporate the water reserve into its planning scheme consistent with State planning policy no. 2.7: *Public drinking water source policy* (WAPC 2003). PDWSAs are commonly shown in planning schemes as special control areas. This provides guidance for state and local government planning decision makers and developers. In the case of this small water reserve, the intention is to ensure that if any other confined aquifer bores are constructed nearby they will meet the *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003 to protect the drinking water supply.

4.2 Defining priority areas

The protection of PDWSAs relies on statutory and non-statutory measures for water resource management and land-use planning. The Department of Water's policy for the protection of PDWSAs includes a system that defines three specific priority areas:

- priority 1 (P1) areas have the fundamental water quality objective of risk avoidance (e.g. state forest and other Crown land)
- priority 2 (P2) areas have the fundamental water quality objective of risk minimisation (e.g. land that is zoned rural)
- priority 3 (P3) areas have the fundamental water quality objective of risk management (e.g. areas zoned urban or light/general industrial).

The determination of priority areas is based on the strategic importance of the land or water source including risks to water quality and quantity, the local planning-scheme zoning, the form of land tenure and existing approved land uses or activities. For further detail, please refer to our Water Quality Protection Note (WQPN) no. 25: *Land use compatibility in public drinking water source areas*.

Water quality protection notes are available <http://drinkingwater.water.wa.gov.au> and scroll down to the link for water quality protection notes.

It is intended to manage the land in the proposed Nannup Water Reserve as P1 because:

- water from these sources constitutes a strategic supply to the Bridgetown Regional Water Supply Scheme
- all the freehold land in the water reserve is owned by the Water Corporation

4.3 Defining protection zones

In addition to priority areas, protection zones are normally defined to protect drinking water sources from contamination in the immediate vicinity of water extraction facilities.

A wellhead protection zone is not considered necessary in this case however, due to the confined nature of the water source and the fenced compound around the production bore.

4.4 Education and awareness raising

Education and awareness raising for the protection of water quality can be achieved through signage and in publication. The department will produce a brochure once this plan is finalised. It will describe the proposed reserve and its location. The brochure will inform people in simple terms about the drinking water source and why it is important to protect it.

5 Recommendations

In order to protect the quality of water in the proposed Nannup Water Reserve the Department of Water recommends the following. The bracketed stakeholders are those expected to have a responsibility for, or an interest in the relevant recommendation being implemented.

1. Proclaim the proposed Nannup Water Reserve under the *Country Areas Water Supply Act 1947* (WA) (Department of Water).
2. Inclusion of the proposed Nannup Water Reserve in the Shire of Nannup local planning scheme in accordance with the WAPC's Statement of planning policy no. 2.7: *Public drinking water source policy* (Shire of Nannup).
3. Confined aquifer bores approved for construction near the proposed Nannup Water Reserve are constructed in accordance with *Minimum construction requirements for water bores in Australia* (Department of Water, proponents).
4. Signs be erected and maintained on the bore compound and boundary of the proposed Nannup Water Reserve (Water Corporation).
5. Review this plan after five years (Department of Water).

Appendices

Appendix A — Figures

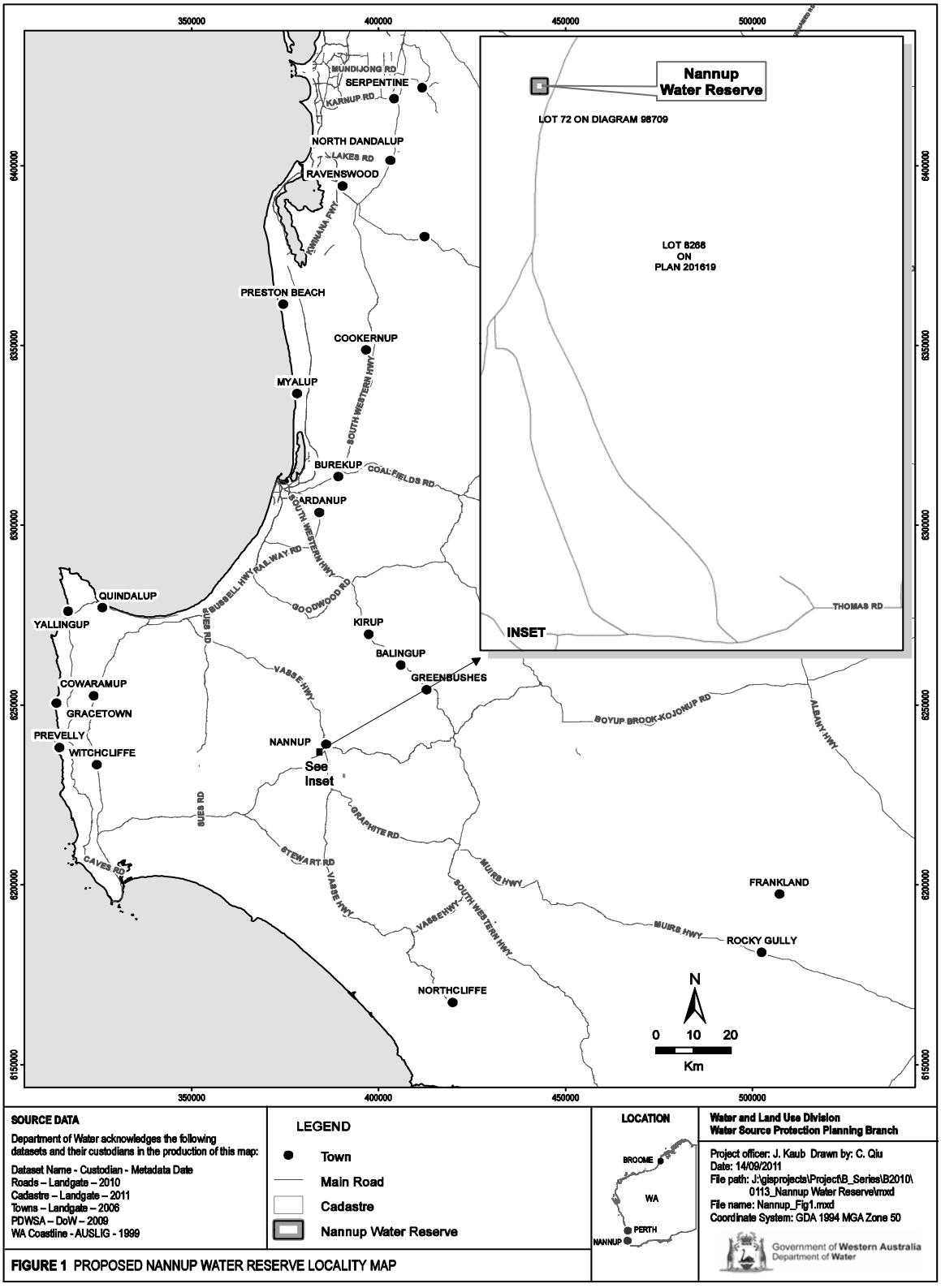

FIGURE 1 PROPOSED NANNUP WATER RESERVE LOCALITY MAP

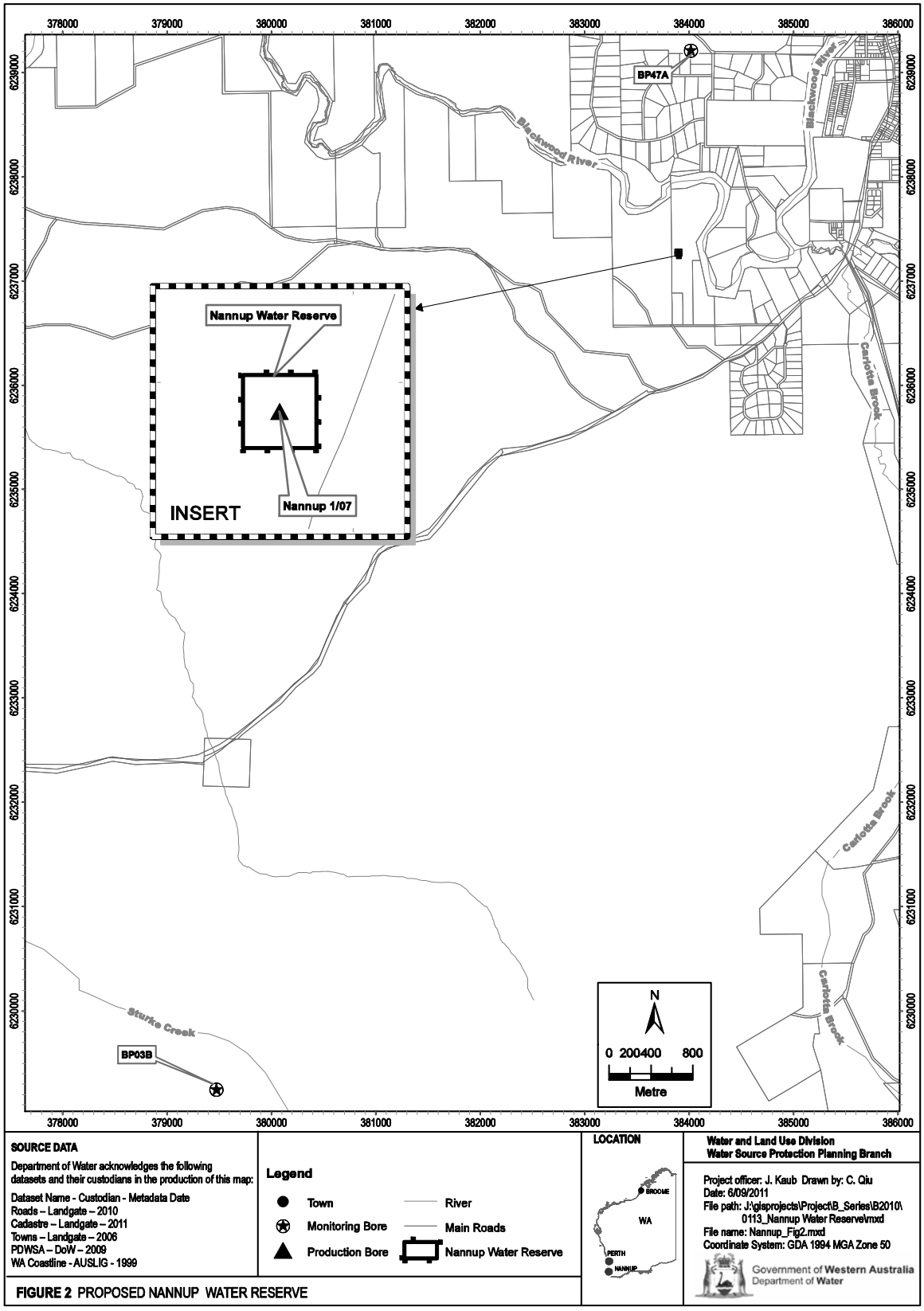

FIGURE 2 PROPOSED NANNUP WATER RESERVE

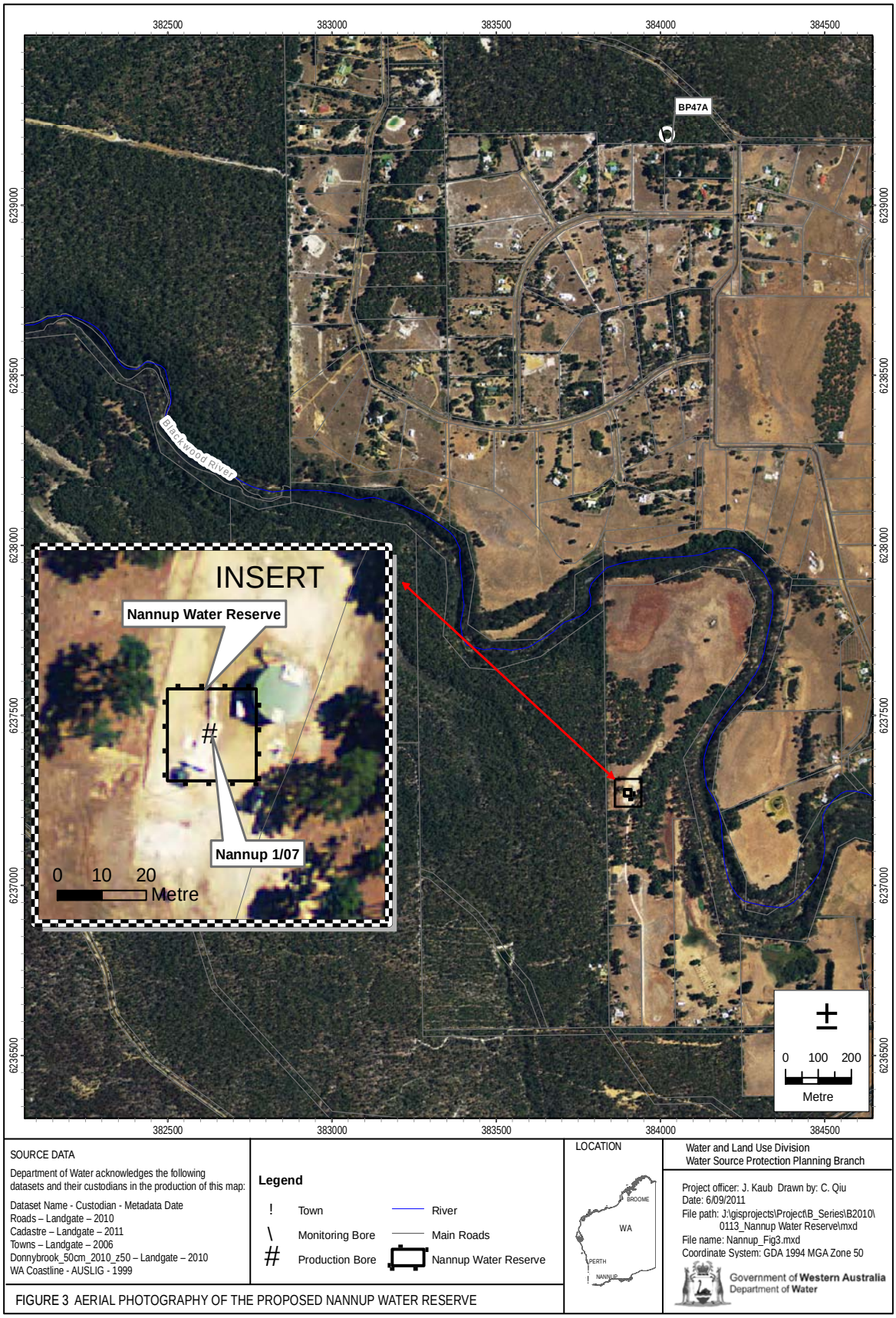

FIGURE 3 AERIAL PHOTOGRAPHY OF THE PROPOSED NANNUP WATER RESERVE

Appendix B — Water quality data

The information in this appendix has been suppliedprovided by the Water Corporation.

The Water Corporation has monitored the raw (source) water quality from Nannup production bore 1/07 in accordance with the requirements of the *Australian drinking water guidelines* (ADWG) and interpretations agreed to with the Department of Health. This data shows the quality of water in the catchment. The raw water is regularly monitored for:

aesthetic characteristics (non-health related)

health-related characteristics, including:

- health related chemicals
- microbiological contaminants

The following data represents the quality of raw water from Nannup production bore 1/07. In the absence of specific guidelines for raw water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Any water quality parameters that have been detected are reported; those that on occasion have exceeded the ADWG are in bold and italics to give an indication of potential raw water quality issues associated with this source. The values are taken from ongoing monitoring for the period February 2010 to September 2011. Typically five years of data is analysed, however this is a new bore therefore there are less than two years of data available at present.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment exist downstream of the raw water to ensure it meets the requirements of the ADWG.

Water from Nannup production bore 1/07 is pumped into storage tanks prior to transfer into Millstream Dam. Water is disinfected by ultraviolet radiation (UV) and chlorination prior to storage in the town reservoirs and subsequent reticulated supply.

For more information on the quality of drinking water supplied to the Bridgetown Regional Water Supply Scheme refer to the most recent Water Corporation drinking water quality annual report at <watercorporation.com.au> What we do > Water quality > Water quality publications > Most recent *Drinking water quality annual report*.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment, to name a few, exist downstream of the raw water to ensure it meets the requirements of the ADWG.

Nannup production bore 1/07

Following is data representative of the quality of raw water in the Yarragadee aquifer at Nannup. In the absence of specific guidelines for raw water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Results that exceed the ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

Aesthetic-related characteristics

The aesthetic water quality analyses for raw water from Nannup production bore 1/07 between February 2010 and September 2011, is summarised in Table 1.

Table B1 Aesthetic-related detections for Nannup production bore 1/07

Parameter	Units	ADWG aesthetic guideline value*	Nannup Bore 1/07 SP	
			Range	Median
Alkalinity as CaCO3	mg/L	Guideline not set	121 - 128	125
Aluminium unfiltered	mg/L	0.2	<0.008 – 0.012	<0.008
Calcium	mg/L	Guideline not set	35 - 36	35
Chloride	mg/L	250	90 – 100	95
Conductivity Laboratory at 25˚C	mg/L	Guideline not set	56 - 62	58
Hardness as CaCO3	mg/L	200	140	140
Iron unfiltered	mg/L	0.3	0.025 – ***0.84***	***0.62***
Magnesium	mg/L	Guideline not set	13	13
Potassium	mg/L	Guideline not set	12 – 13	12.5
Silicon as SiO2	mg/L	Guideline not set	18 – 20	18
Sodium	mg/L	180	48 - 50	49.5
Total filterable solids by summation	mg/L	500	380 – 394	386
Turbidity	NTU	5	0.2 – ***8.1***	3
pH measured in laboratory	No unit	6.5 – 8.5	7.42 – 8.11	7.59

* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

Health-related characteristics

Health parameters

Raw water from Nannup production bore 1/07 (drawing from the Yarragadee Aquifer) is analysed for chemicals that are harmful to human health including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related water quality parameters that have been measured at detectable levels in the source, between February 2010 and September 2011, are summarised in Table 2.

Table B2 Health-related detections for Nannup production bore 1/07

Parameter	Units	ADWG health guideline value*	Nannup Bore 1/07 SP	
			Range	Median
Fluoride	mg/L	1.5	0.15	0.15
Manganese unfiltered	mg/L	0.5 (health) 0.1 (aesthetic)	0.04 – ***0.14***	***0.14***
Sulphate	mg/L	500	11	11

* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & ARMCANZ, 2004).

Pesticide and hydrocarbon sampling were undertaken, there were no detections.

Microbiological contaminants

Microbiological testing of raw water samples from Nannup production bore 1/07 is currently conducted on an annual basis, however weekly *Escherichia coli* sampling is undertaken from the raw water point of Millstream Dam (which stores water from Nannup Bore 1/07). *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals.

A detection of *Escherichia coli* in raw water abstracted from any bore may indicate contamination of faecal material through ingress into the bore, or recharge through to the aquifer (depending on aquifer type).

During the review period of February 2010-September 2011, only two samples were taken. These water samples did not record positive *Escherichia coli* counts.

Appendix C — Photographs

Figure C1 Land immediately to the east of Nannup production bore 1/07 sloping towards the Blackwood River below

Figure C2 Nannup production bore 1/07 compound viewed from the eastern side

Figure C3 Nannup production bore 1/07 compound viewed from the western side

Appendix D — How do we protect public drinking water source areas?

The *Australian drinking water guidelines* (ADWG) (NHMRC & NRMMC 2011) outline how we should protect drinking water in Australia. The ADWG recommends a 'catchment to consumer' framework that uses a preventive risk-based and multiple-barrier approach. A similar approach is recommended by the World Health Organization.

The 'catchment to consumer' framework applies across the entire drinking water supply system – from the water source to your tap. It ensures a holistic assessment of water quality risks and solutions to ensure the delivery of a reliable and safe drinking water to your home.

A preventive risk-based approach means that we look at all the different risks to water quality, in order to determine what risks can reasonably be avoided and what risks need to be minimised or managed. This approach means that the inherent risks to water quality are as low as possible. A multiple-barrier approach means that we use different barriers against contamination at different stages of a drinking water supply system.

The first and most important barrier is protecting the catchment. If we get this barrier right, it has a 'flow-on effect' that can result in a lower cost, safer drinking water supply. Other barriers against contamination include storage of water to help reduce contaminant levels, disinfecting the water (e.g. chlorination to inactivate pathogens), maintenance of pipes and testing of water quality. Another community benefit of catchment protection is its complementary nature to conservation initiatives.

Research and experience shows that a combination of catchment protection and water treatment is safer than relying on either barrier on its own. That's why this drinking water source protection review is important. We should not forget that ultimately it's about protecting your health, and about protecting the catchment's water quality now and for the future.

In Western Australia, the Department of Water protects public drinking water source areas (PDWSAs) by putting the ADWG into practice, writing plans, policies and guidelines, and providing input into land-use planning.

The *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (WA) and the *Country Areas Water Supply Act 1947* (WA) provide us with the tools we need to protect water quality in PDWSAs. These tools allow us to assess and manage the water quality contamination risks from different land uses and activities. We work cooperatively with other agencies in the implementation of this legislation.

An important step in maximising the protection of water quality in PDWSAs is to define priority areas and protection zones to help guide land use planning and to identify where legislation applies. There are three different priority areas. Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality

of the drinking water source using the principle of risk avoidance. Priority 2 (P2) areas are defined and managed to maintain or improve the quality of the drinking water source using the principle of risk minimisation. Priority 3 (P3) areas are defined and managed to maintain the quality of the drinking water source for as long as possible using the principle of risk management. Protection zones surround drinking water extraction points (such as bores and reservoirs), so that the most vulnerable areas may be protected from contamination.

If you would like more information about the ADWG and how we protect drinking water in Western Australia, go to <http://drinkingwater.water.wa.gov.au> or email drinkingwater@water.wa.gov.au.

List of shortened forms

ADWG	Australian drinking water guidelines
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BRWSS	Bridgetown Regional Water Supply Scheme
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NTU	Nephelometric turbidity units
PDWSA	Public drinking water source area
TDS	Total dissolved solids
WAPC	Western Australian Planning Commission
WQPN	Water Quality Protection Note

Glossary

Abstraction The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.

Aesthetic guideline value The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, e.g. appearance, taste and odour (NHMRC & NRMMC 2004).

Allocation The quantity of water that a licensee is permitted to abstract is their allocation, usually specified in kilolitres per annum (kL/a).

Augment Augment means to increase the available water supply. For example, pumping back water from a secondary storage/reservoir dam.

Australian drinking water guidelines The *National water quality management strategy: Australian drinking water guidelines 6*, 2004 (NHMRC & NRMMC 2004) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's Bibliography).

Bore field A group of bores to monitor or withdraw groundwater is referred to as a bore field.

Catchment The physical area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.

Electrical conductivity This estimates the volume of TDS or the total volume of dissolved ions in a solution (water) corrected to 25ºC. Measurement units include millisiemens per metre and microsiemens per centimetre.

Graben An elongated depression of rock between two geological faults.

Health guideline value The concentration or measure of a water quality characteristic that, based on current knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHMRC & NRMMC 2004).

Hydrocarbons A class of compounds containing only hydrogen and carbon, such as methane, ethylene, acetylene and benzene. Fossil fuels such as oil, petroleum and natural gas all contain hydrocarbons.

mg/L A milligram per litre (0.001 grams per litre) is a measurement of a total dissolved solid in a solution.

Nephelometric turbidity units Nephelometric turbidity units are a measure of turbidity in water.

Nutrients	Minerals, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate), dissolved in water which provide nutrition (food) for plant growth.
Pathogen	A disease-producing organism that can cause sickness and sometimes death through the consumption of water, including bacteria (such as *Escherichia coli*), protozoa (such as *Cryptosporidium* and *Giardia*) and viruses.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
pH	A logarithmic scale for expressing the acidity or alkalinity of a solution. A pH below seven indicates an acidic solution and above seven indicates an alkaline solution.
Pollution	Water pollution occurs when waste products or other substances (effluent, litter, refuse, sewage or contaminated runoff) change the physical, chemical or biological properties of the water, adversely affecting water quality, living species and beneficial uses.
Public drinking water source area	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* (WA) and the *Country Areas Water Supply Act 1947* (WA).
Recharge	Recharge is the action of water infiltrating through the soil/ground to replenish an aquifer.
Recharge area	An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
Scheme supply	Water diverted from a source or sources by a water authority or private company and supplied via a distribution network to customers for urban and industrial use or for irrigation.
Total dissolved solids	Total dissolved solids consist of inorganic salts and small amounts of organic matter that are dissolved in water. Clay particles, colloidal iron and manganese oxides, and silica fine enough to pass through a 0.45 micrometer filter membrane can also contribute to total dissolved solids. Total dissolved solids comprise sodium, potassium, calcium, magnesium, chloride, sulfate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate (and nitrite) and phosphate (NHMRC & NRMMC 2004).

Total filterable solids by summation	Total filterable solids by summation is a water quality test which is a total of the following ions: Na (sodium), K (potassium), Ca (calcium), Mg (magnesium), Cl equivalent (chloride), alkalinity equivalent, SO_4 equivalent (sulfate) or S (sulfur) in grams, Fe (iron), Mn (manganese), and SiO_2 (silicon oxide). It is used as a more accurate measure than total dissolved solids (TDS). The higher the value, the more solids that are present and generally the saltier the taste.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
True colour units	True colour units are a measure of degree of colour in water.
Turbidity	The cloudiness or haziness of water caused by the presence of fine suspended matter.
Water quality	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.

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Department of **Water**
168 St Georges Terrace, Perth, Western Australia
PO Box K822 Perth Western Australia 6842
Phone: 08 6364 7600
Fax: 08 6364 7601
www.water.wa.gov.au

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